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**United States Patent** [19][11] **Patent Number:** **5,582,700****Bryning et al.**[45] **Date of Patent:** **Dec. 10, 1996****[54] ELECTROPHORETIC DISPLAY UTILIZING PHASE SEPARATION OF LIQUIDS****[75] Inventors:** **Zbigniew Bryning**, Campbell; **Remy Cromer**, San Jose, both of Calif.**[73] Assignee:** **Zikon Corporation**, Calif.**[21] Appl. No.:** **543,707****[22] Filed:** **Oct. 16, 1995****[51] Int. Cl.<sup>6</sup>** ..... **G01N 27/26; G01N 27/447****[52] U.S. Cl.** ..... **204/450; 204/600; 345/105; 345/107****[58] Field of Search** ..... **204/450, 600; 345/107, 105****[56] References Cited****U.S. PATENT DOCUMENTS**

3,612,758	10/1971	Evans et al.	348/803
3,668,106	6/1972	Ota	358/305
3,756,693	9/1973	Ota	345/107
4,218,302	8/1980	Dalisa et al.	359/296
4,272,596	6/1981	Harbour et al.	430/37
4,419,663	12/1983	Kohashi	345/107
5,181,016	1/1993	Lee	345/84

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An electrophoretic display is provided which includes first

and second plates spaced apart to define a volume of space therebetween. The display also includes a first electrode positioned on the first plate, a second electrode positioned on the second plate, and an emulsion positioned within the space. The emulsion includes a non-polar phase forming a continuous phase of the emulsion and a polar phase forming a non-continuous phase of the emulsion.

The polar phase of the emulsion is capable of forming droplets (reverse micelles or reverse emulsions) in the non-polar phase. The polar phase includes a dye which is insoluble in the non-polar phase, a polar solvent, and a detergent. Images are provided by the display by controlling the distribution of the polar phase droplets containing the dye in the non-polar liquid phase using an electric field formed between the first and second electrodes.

A method is also provided for forming an image by electrophoretic phase separation of an emulsion. According to the method, an emulsion is formed between the non-polar phase which constitutes a continuous phase of the emulsion and the polar phase which constitutes a non-continuous phase of the emulsion. The polar phase forms droplets in the non-polar phase, the polar phase including a dye, a polar solvent, and a detergent. An image is formed in the display by applying an electric field across the emulsion which causes the polar phase droplets to redistribute themselves relative to the non-polar phase, redistribution including the coagulation of the polar phase in the non-polar phase as well as the separation of the polar phase from the non-polar phase.

**32 Claims, 17 Drawing Sheets**